

1 **The Electrocardiogram (ECG)**

2 **The ECG**

- The ECG is a voltmeter
 - Records electrical voltages (potentials) generated by depolarization of heart muscle
- Electrical activity within the heart can be observed by means of electrodes connected by cables to an ECG machine

3 **The ECG**

- Can provide information about:
 - The orientation of the heart in the chest
 - Conduction disturbances
 - The electrical effects of medications and electrolytes
 - The mass of cardiac muscle
 - The presence of ischemic damage

4 **The ECG**

- Does not provide information about the mechanical (contractile) condition of the myocardium
 - Evaluated by assessment of pulse and blood pressure

5 **Electrodes**

- Disposable disk electrodes contain conductive media
 - Conductive media conducts the skin surface voltage change through color-coded wires to a cardiac monitor
- Applied at specific locations on the patient's chest wall and extremities

6 **Leads**

- A **lead** is a record of electrical activity between two electrodes
 - Allow viewing of the heart's electrical activity in two different planes: frontal (coronal) or horizontal (transverse)
- Each lead records the average current flow at a specific time in a portion of the heart

7 **Types of Leads**

- There are three types of leads:
 - Standard limb leads
 - Augmented leads
 - Precordial (chest) leads

8 **Leads**

- Think of the positive electrode as an eye
 - The position of the positive electrode on the body determines the portion of the heart "seen" by each lead

9 **Waveform Deflections**

- If the wave of depolarization moves toward the positive electrode, the waveform recorded on the ECG graph paper will be upright
- If the wave of depolarization moves toward the negative electrode, the waveform produced will be inverted

10 **Waveform Deflections**

- A biphasic (partly positive, partly negative) waveform is recorded when the wave of depolarization moves perpendicularly to the positive electrode
- When electrical activity is not detected, a straight line is recorded called the "baseline" or "isoelectric" line

11 **Frontal Plane Leads**

- Six leads view the heart in the frontal plane as if the body were flat: three bipolar leads and three unipolar leads

- Bipolar lead
 - A lead that consists of a positive and negative electrode
 - Leads I, II, and III

12 **Frontal Plane Leads**

- Unipolar lead
 - A lead that consists of a single positive electrode and a reference point
 - Augmented limb leads
 - Leads aVR, aVL, and aVF

13 **Horizontal Plane Leads**

- Six precordial (chest or V) leads view the heart in the horizontal plane
- Precordial leads - V1, V2, V3, V4, V5, and V6

14 **Standard Limb Leads**

- Leads I, II, and III make up the standard limb leads
- In the bipolar leads:
 - Right arm electrode is always negative
 - Left leg electrode is always positive

15 **Lead I**

- Records the difference in electrical potential between the left arm (+) and right arm (–) electrodes
- Views the lateral wall of the left ventricle

16 **Lead II**

- Records the difference in electrical potential between the left leg (+) and right arm (–) electrodes
- Views the inferior surface of the left ventricle

17 **Lead III**

- Records the difference in electrical potential between the left leg (+) and left arm (–) electrodes
- Views the inferior surface of the left ventricle

18 **Limb Leads – Waveform Comparison**

19 **Summary of Standard Limb Leads**

20 **Modified Chest Leads**

- The modified chest leads (MCLs) are bipolar precordial (chest) leads that are variations of the unipolar precordial leads
 - Each MCL consists of a positive and negative electrode applied to a specific location on the thorax

21 **Modified Chest Leads**

- MCLs are useful in:
 - Detecting bundle branch blocks
 - Differentiating SVT from VT

22 **Lead MCL₁**

- A variation of the precordial lead V₁
 - Negative electrode below left clavicle toward left shoulder

- Positive electrode right of sternum in 4th intercostal space
 - Views the ventricular septum
- 23 **Lead MCL₁**
- Because the primary wave of depolarization is directed toward the left ventricle, the QRS complex recorded in this lead will normally appear negative
- 24 **Lead MCL₆**
- A variation of precordial lead V₆
 - Negative electrode below left clavicle toward left shoulder
 - Positive electrode 5th intercostal space, left midaxillary line
 - Views the low lateral wall of the left ventricle
- 25 **Augmented Limb Leads**
- Leads aVR, aVL, and aVF make up the augmented limb leads
 - A = augmented
 - V = voltage
 - R = right arm
 - L = left arm
 - F = foot (usually the left leg)
 - Unipolar leads
 - Consist of only one electrode on the _____ body surface
- 26 **Augmented Limb Leads**
- Lead aVR
 - Views the heart from the right shoulder
 - Does not view any wall of the heart
 - Lead aVL
 - Views the heart from the left shoulder
 - Oriented to the lateral wall of the left ventricle
 - Lead aVF
 - Views the heart from the left foot (leg)
 - Views the inferior surface of the left ventricle
- 27 **Summary of Augmented Leads**
- 28 **Precordial (Chest) Leads**
- The six precordial leads are unipolar leads
 - View the heart in the horizontal plane
 - Identified as V₁, V₂, V₃, V₄, V₅, and V₆
 - Each electrode placed in a V position is a positive electrode
 - Leads V₁ and V₂ lie over the right ventricle
 - Leads V₃ and V₄ lie over the interventricular septum
 - Leads V₅ and V₆ lie over the left ventricle
- 29 **Precordial (Chest) Leads**
- 30 **Summary of Precordial Leads**
- 31 **Right Precordial Leads**
- Used to view the right ventricle
 - Placement identical to standard precordial leads except on the right side of the chest
 - If time does not permit obtaining all of the right precordial leads, V₄R is the lead of choice
- 32 **Posterior Precordial Leads**
- Used to view the posterior surface of the heart
 - Placed on the same horizontal line as V₄ to V₆
 - V₇ - posterior axillary line
 - V₈ - posterior scapular line
 - V₉ - left border of spine
- 33 **ECG Paper**

34 **ECG Paper**

- ECG paper is graph paper made up of small and larger, heavy-lined squares
 - Smallest squares are 1 mm wide and 1 mm high
 - 5 small squares between the heavier black lines
 - 25 small squares within each large square

35 **Horizontal Axis = Time**

- Width of each small box = 0.04 second
- Width of each large box (5 small boxes) = 0.20 second
 - 5 large boxes (each consisting of 5 small boxes) = 1 second
 - 15 large boxes = 3 seconds
 - 30 large boxes = 6 seconds

36 **Vertical Axis = Voltage/Amplitude**

- Size or amplitude of a waveform is measured in millivolts (voltage) or millimeters (amplitude)

37 **Calibration**

- When the ECG machine is properly calibrated, a 1-millivolt electrical signal will produce a deflection that measures exactly 10 millimeters tall

38 **Artifact**

- Distortion of an ECG tracing by electrical activity that is noncardiac in origin
- Can mimic various cardiac dysrhythmias, including ventricular fibrillation
- Patient evaluation essential before initiating any medical intervention

39 **Causes of Artifact**

- Loose electrodes
- Broken ECG cables or broken wires
- Muscle tremor
- Patient movement
- External chest compressions
- 60-cycle interference

40 **Artifact – Loose Electrodes**

41 **Artifact – Muscle Tremor**

42 **Artifact – 60-cycle Interference**